APPENDIX B
COUPON MANUFACTURING DOCUMENTATION

COUPON S1A

Northwest Machining and Mfg., Inc.
1957 LANARK STREET • MERIDIAN, IDAHO 83642
PHONE (208) 888-5334 • FAX (208) 888-0917
e-mail nwmm@micron.net

Date: 12/02/00

Job Order Number: 14552

Customer: GENERAL ATOMICS

Part Number: S1A REV: ~~A~~ B DEC 0 2 2000

Description: COUPON

Quantity: 22

Purchase Order Number: H030105

Customer Supplied Material? NO

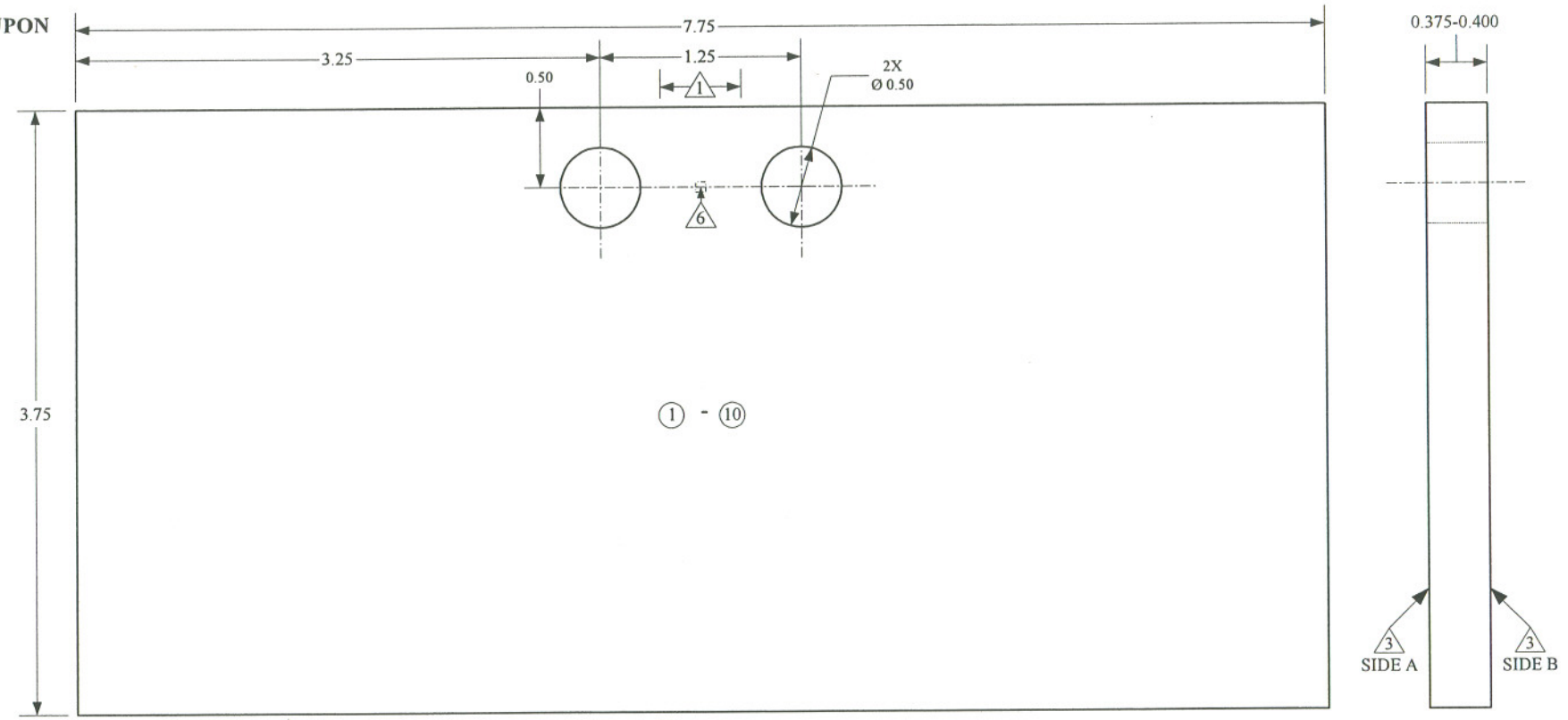
CERTIFICATION OF CONFORMANCE

NORTHWEST MACHINING & MFG., INC., DOES HEREBY CERTIFY THAT PARTS MANUFACTURED UNDER THE ABOVE NOTED PURCHASE ORDER WERE PRODUCED AS STIPULATED BY THAT PURCHASE ORDER.

IT IS FURTHER CERTIFIED THAT TEST REPORTS VERIFYING COMPLIANCE WITH DESIGN STANDARDS, MATERIAL CONTROLS, & INSPECTION REQUIREMENTS NOTED ON THE PURCHASE ORDER, ARE ON FILE AND AVAILABLE UPON REQUEST.

SIGNED: Sid Harmon
SID HARMON / (QCM)

COUPON



NOTES

1. SERIALIZE THE COUPONS S1A-01 TO S1A-22 ON TOP EDGE AT NOTED LOCATION USING 0.25 IMPRESSION STAMP, 0.004-0.008 DEEP
2. HEAT TREAT AND PROCESS TO 260-280 KSI ULTIMATE TENSILE STRENGTH PER AMS-H-6875, MAXIMUM ALLOWABLE DECARBURIZATION 0.003
3. $0.025\sqrt{\frac{125}{M}\ \frac{64}{}}$ BEFORE 2, $\sqrt{\frac{125}{M}\ \frac{64}{}}$ AFTER 2
4. BREAK ALL SHARP EDGES 0.005-0.015
5. FLUORESCENT MAGNETIC PARTICLE INSPECT PER ASTM E1444
6. FOR COUPONS WITH EVEN SERIAL NUMBERS: PERFORM ROCKWELL HARDNESS C TEST PER ASTM A370 AT NOTED LOCATION
7. FOR COUPONS WITH EVEN SERIAL NUMBERS: PERFORM SURFACE ROUGHNESS MEASUREMENT PER ASME B46.1

① – ⑩ MARK SIDE A WITH DATA MATRIX™ SYMBOLS

ALGLE PROGRAM	TITLE: COUPON	DRAWING NUMBER: S1A	REVISION: B	DIMENSIONS: ALL DIMENSIONS IN INCHES	TOLERANCES: UNLESS OTHERWISE NOTED X.X = ± 0.1, X.XX = ± 0.05, ANGLES = ± 0.5°	DRAWN: JOHN COATES
DPM EVALUATION	MATERIAL: 4340 PER AMS 6415	DATE: 10/18/00	SHEET: 1 OF 1	SCALE: NOT TO SCALE		CHECKED: FRANK ZUECH

COUPON A1A

Northwest Machining and Mfg., Inc.
1957 LANARK STREET • MERIDIAN, IDAHO 83642
PHONE (208) 888-5334 • FAX (208) 888-0917
e-mail nwmm@micron.net

Date: 12/02/00

Job Order Number: 14556

Customer: GENERAL ATOMICS

Part Number: A1A REV: A B DEC 02 2000

Description: COUPON

Quantity: 22

Purchase Order Number: H030105

Customer Supplied Material? NO

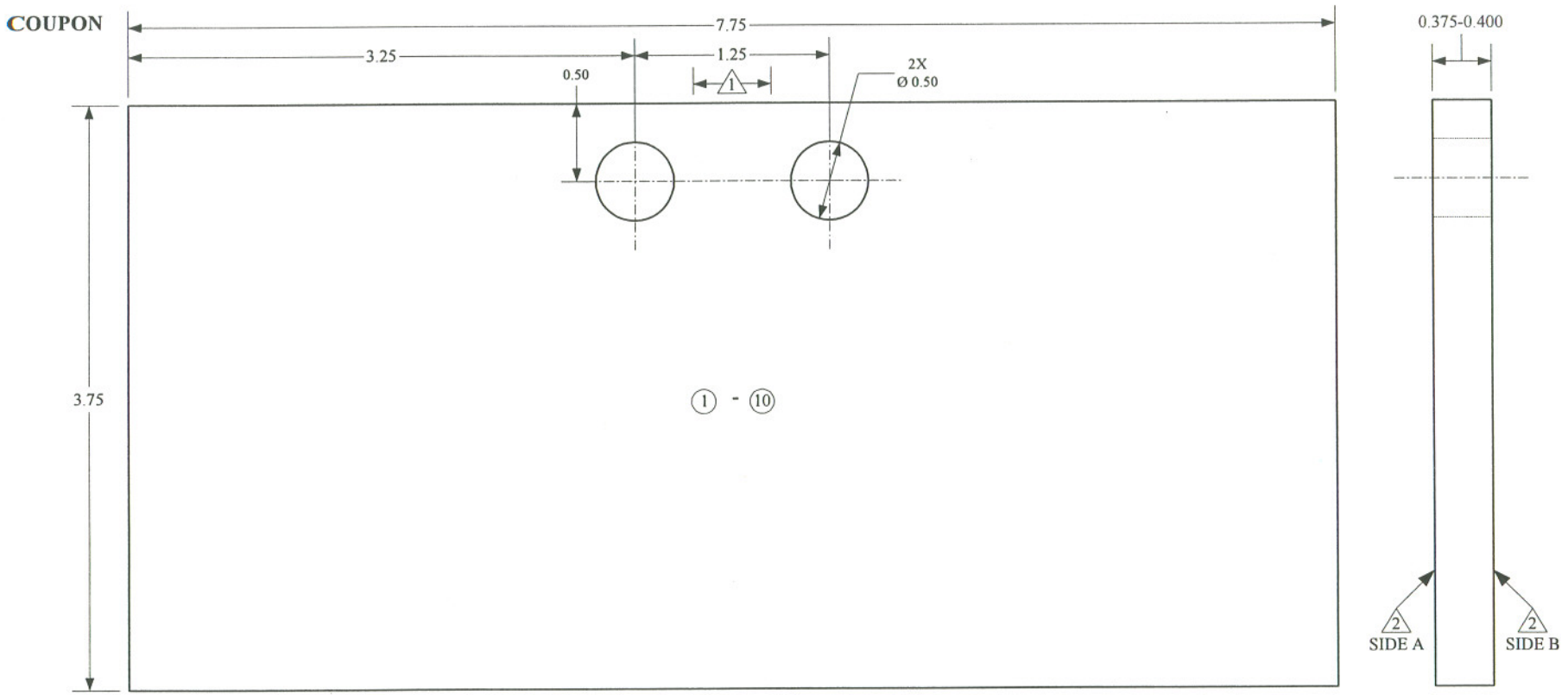
CERTIFICATION OF CONFORMANCE

NORTHWEST MACHINING & MFG., INC., DOES HEREBY CERTIFY THAT PARTS MANUFACTURED UNDER THE ABOVE NOTED PURCHASE ORDER WERE PRODUCED AS STIPULATED BY THAT PURCHASE ORDER.

IT IS FURTHER CERTIFIED THAT TEST REPORTS VERIFYING COMPLIANCE WITH DESIGN STANDARDS, MATERIAL CONTROLS, & INSPECTION REQUIREMENTS NOTED ON THE PURCHASE ORDER, ARE ON FILE AND AVAILABLE UPON REQUEST.

SIGNED:

SID HARMON / (QCM)



NOTES

1. SERIALIZE THE COUPONS A1A-01 TO A1A-22 ON TOP EDGE AT NOTED LOCATION USING 0.25 IMPRESSION STAMP, 0.004-0.008 DEEP
2. $0.025\sqrt{\ }$ $\frac{125}{64}$ M
3. BREAK ALL SHARP EDGES 0.005-0.015
4. FLUORESCENT PENETRANT INSPECT PER ASTM E1417
5. FOR COUPONS WITH EVEN SERIAL NUMBERS: PERFORM CONDUCTIVITY TESTS PER MIL-STD-1537
6. FOR COUPONS WITH EVEN SERIAL NUMBERS: PERFORM SURFACE ROUGHNESS MEASUREMENT PER ASME B46.1

(1) – (10) MARK SIDE A WITH DATA MATRIX™ SYMBOLS

ALGLE PROGRAM	TITLE: COUPON	DRAWING NUMBER: A1A	REVISION: B	DIMENSIONS: ALL DIMENSIONS IN INCHES	TOLERANCES: UNLESS OTHERWISE NOTED X.X = ± 0.1, X.XX = ± 0.05, ANGLES = ± 0.5°	DRAWN: JOHN COATES
DPM EVALUATION	MATERIAL: 7075-T7351 PER AMS 4078 (0.5 INCH PLATE)	DATE: 10/18/00	SHEET: 1 OF 1	SCALE: NOT TO SCALE		CHECKED: FRANK ZUECH

APPENDIX C
COUPON DPM PROCESS DOCUMENTATION

Aging Landing Gear Life Extension Program
M-E-39035-112-10000-19

MEMORANDUM

To: Don Roxby, RVSI
From: John Coates, MGB
Date: March 7, 2003
Subject: Statement of Work for RVSI CI Acuity Matrix, Symbology Research Center
Marking Coupons for DPM Evaluation for the NCMS Retrograde Parts Identification Project

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Background

Under the ALGLE Program, testing will be conducted for OO-ALC/LGHLEN to evaluate the survivability of marks applied with direct part marking (DPM) processes for normal aircraft landing gear part overhaul conditions (NALGPOC). The marking for the testing will be conducted under the NCMS Retrograde Parts Identification Project. Based on results from previous testing, laser engraving, dot peening, and micro milling were selected for further testing. The further testing is to evaluate mark improvements. Specifically the mark cells must have radii to reduce stress concentration and tapered sides to reduce clogging.

Mark and Deliver

1. Mark Optimization*
   - 1.1 Determine the optimum process controls for each marking process that provides a mark with no material property degradation and overhaul process survivability. Determine the optimum process controls for each marking process by producing marks using different process controls on coupons S1A-01 to S1A-04 and coupons A1A-01 to A1A-04.
   - 1.2 Use the optimum process controls for each marking process to mark the remaining coupons.
2. Steel Coupons*
   - 2.1 Mark and deliver coupons S1A-17 to S1A-20 in accordance with drawing S1A REV D requirements.
   - 2.2 Mark and deliver coupons S2A-07 to S2A-10 in accordance with drawing S2A REV D requirements.
3. Aluminum Coupons*
   - 3.1 Mark and deliver coupons A1A-17 to A1A-20 in accordance with drawing A1A REV D requirements.
   - 3.2 Mark and deliver coupons A2A-07 to A2A-10 in accordance with drawing A2A REV D requirements.

* For each marking process, provide appropriate mark masking to ensure that the marking process does not interfere or damage previously applied marks.
* RVSI will not mark the coupons with VibroPeen or Steel Stamp.

Documentation

1. Provide documentation for the marking processes. (2 Page Maximum)
   - 1.1 Documentation of the optimum process controls for each marking process.
   - 1.2 Mark verification for each mark.
   - 1.3 Explanations of any anomalies.

Handling and Packaging

1. Coat coupons in light oil between the marking processes and before delivery to prevent corrosion.

Schedule

1. Delivery by March 31, 2003

Contacts

MGB: Engineering	Mr. John Coates	Phone: (801) 825-9443 EXT 110
RVSI: Research and Development	Mr. Don Roxby	Phone: (256) 830-8123

TABLE III: MARK REQUIREMENTS

(1) DEEP LASER ENGRAVE MARKS IN DETAIL III PER NASA-HDBK-6003 (P027)

(2) DOT PEEN MARKS IN DETAIL III PER NASA-HDBK-6003 (P027)

(3) MICRO MILL MARKS IN DETAIL III PER NASA-HDBK-6003 (P027)

(4) VIBROPEEN MARKS IN DETAIL III PER OO-ALC/MANPP PROCEDURE

(5) IMPRESSION STAMP MARKS IN DETAIL III PER OO-ALC/MANPP PROCEDURE

(6) – (10) NOT APPLICABLE

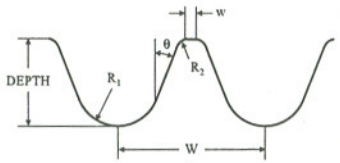
DETAIL III: NOTES AND CELL DETAIL

III.1 LINES AND BOXES INDICATE LOCATIONS FOR MARKS

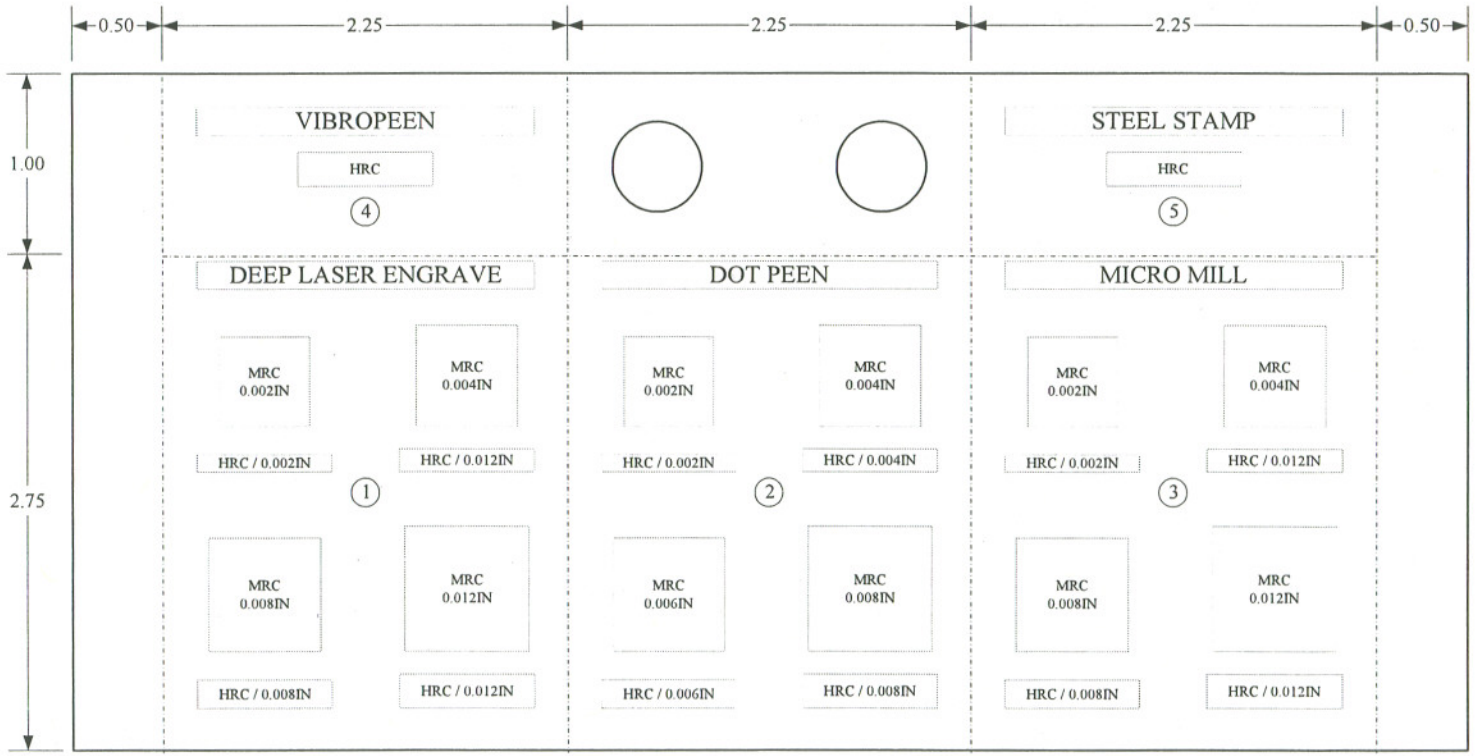
III.2 MRC / MACHINE READABLE CODE: 22 X 22 DATA MATRIX / DEPTH INDICATED IN BOXES

III.3 HRC / HUMAN READABLE CODE: 10 NUMBERS / DEPTH INDICATED IN BOXES
EACH HRC SHALL BE A DIFFERENT RANDOM NUMBER

III.4 MRC AND HRC CELLS SHALL INCLUDE RADII AND TAPERS AS SHOWN



DETAIL III: FIGURE



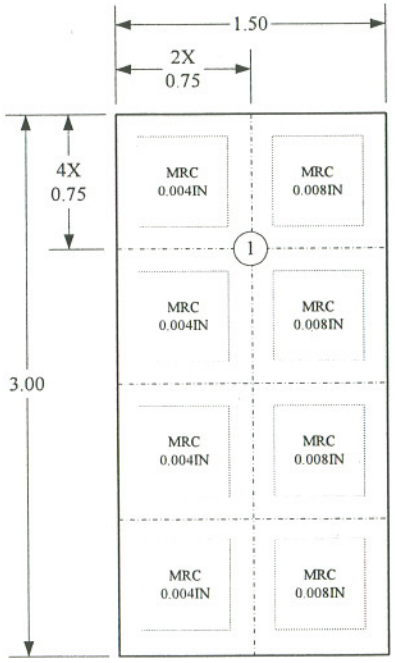
ALGLE PROGRAM	TITLE: COUPON	DRAWING NUMBER: S1A	REVISION: D	DIMENSIONS: ALL DIMENSIONS IN INCHES	TOLERANCES: UNLESS OTHERWISE NOTED X.X = ± 0.1 X.XX = ± 0.05 ANGLES = ± 0.5°	DRAWN: JOHN COATES
DPM EVALUATION	MATERIAL: 4340 PER AMS 6415	DATE: 2/28/03	SHEET: 4 OF 4	SCALE: NOT TO SCALE		CHECKED: FRANK ZUECH

TABLE II: MARK REQUIREMENTS

(1) DEEP LASER ENGRAVE MARKS IN DETAIL II PER NASA-HDBK-6003 (P027)

(2) – (10) NOT APPLICABLE

DETAIL II: FIGURE

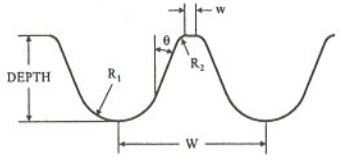


DETAIL II: NOTES AND CELL DETAIL

III.1 LINES AND BOXES INDICATE LOCATIONS FOR MARKS

III.2 MRC / MACHINE READABLE CODE: 18 X 18 DATA MATRIX / DEPTH INDICATED IN BOXES

III.3 MRC CELLS SHALL INCLUDE RADII AND TAPERS AS SHOWN



ALGLE PROGRAM	TITLE: COUPON	DRAWING NUMBER: S2A	REVISION: D	DIMENSIONS: ALL DIMENSIONS IN INCHES	TOLERANCES: UNLESS OTHERWISE NOTED X.X = ± 0.1 X.XX = ± 0.05 ANGLES = ± 0.5°	DRAWN: JOHN COATES
DPM EVALUATION	MATERIAL: 4340 PER AMS 6415	DATE: 2/28/03	SHEET: 3 OF 3	SCALE: NOT TO SCALE		CHECKED: FRANK ZUECH

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(3) MICRO MILL MARKS IN DETAIL III PER NASA-HDBK-6003 (P027)

(4) VIBROPEEN MARKS IN DETAIL III PER OO-ALC/MANPP PROCEDURE

(5) IMPRESSION STAMP MARKS IN DETAIL III PER OO-ALC/MANPP PROCEDURE

(6) – (10) NOT APPLICABLE

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III.2 MRC / MACHINE READABLE CODE: 22 X 22 DATA MATRIX / DEPTH INDICATED IN BOXES

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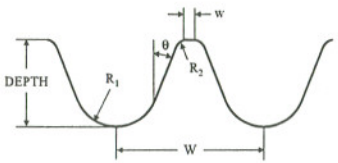
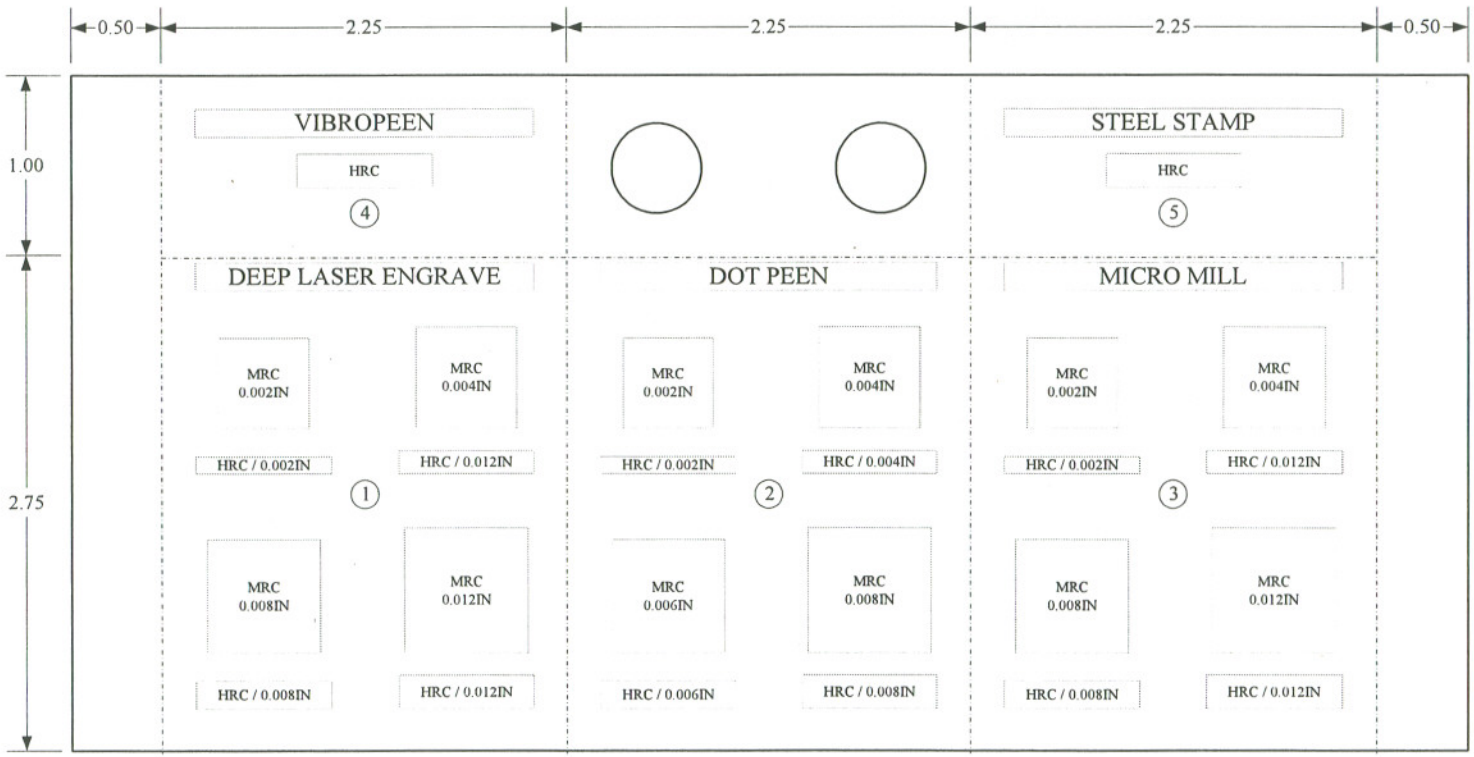
EACH HRC SHALL BE A DIFFERENT RANDOM NUMBER

III.4 MRC AND HRC CELLS SHALL INCLUDE RADII AND TAPERS AS SHOWN



DETAIL III: FIGURE



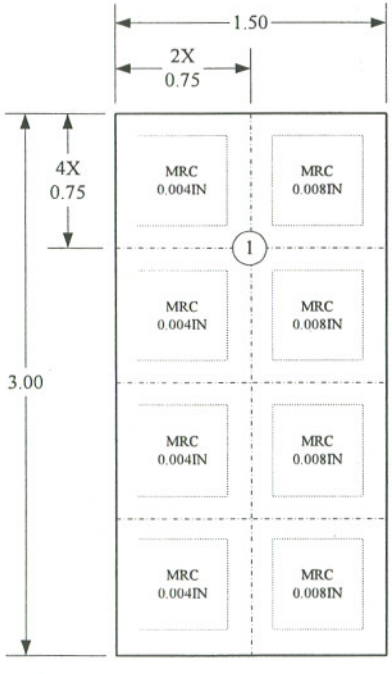
ALGLE PROGRAM	**TITLE** COUPON	**DRAWING NUMBER** A1A	**REVISION** D	**DIMENSIONS** ALL DIMENSIONS IN INCHES	**TOLERANCES** UNLESS OTHERWISE NOTED X.X = ± 0.1 X.XX = ± 0.05 ANGLES = ± 0.5°	**DRAWN** JOHN COATES
DPM EVALUATION	**MATERIAL** 7075-T7351 PER AMS 4078 (0.5 INCH PLATE)	**DATE** 2/28/03	**SHEET** 4 OF 4	**SCALE** NOT TO SCALE		**CHECKED** FRANK ZUECH

TABLE II: MARK REQUIREMENTS

(1) DEEP LASER ENGRAVE MARKS IN DETAIL II PER NASA-HDBK-6003 (P027)

(2) – (10) NOT APPLICABLE

DETAIL II: FIGURE

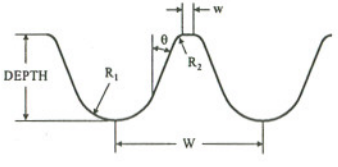


DETAIL II: NOTES AND CELL DETAIL

III.1 LINES AND BOXES INDICATE LOCATIONS FOR MARKS

III.2 MRC / MACHINE READABLE CODE: 18 X 18 DATA MATRIX / DEPTH INDICATED IN BOXES

III.3 MRC CELLS SHALL INCLUDE RADII AND TAPERS AS SHOWN



ALGLE PROGRAM	TITLE: COUPON	DRAWING NUMBER: A2A	REVISION: D	DIMENSIONS: ALL DIMENSIONS IN INCHES	TOLERANCES: UNLESS OTHERWISE NOTED X.X = ± 0.1 X.XX = ± 0.05 ANGLES = ± 0.5°	DRAWN: JOHN COATES
DPM EVALUATION	MATERIAL: 7075-T7351 PER AMS 4078 (0.5 INCH PLATE)	DATE: 2/28/03	SHEET: 3 OF 3	SCALE: NOT TO SCALE		CHECKED: FRANK ZUECH

RVSI
Symbology
Research Center

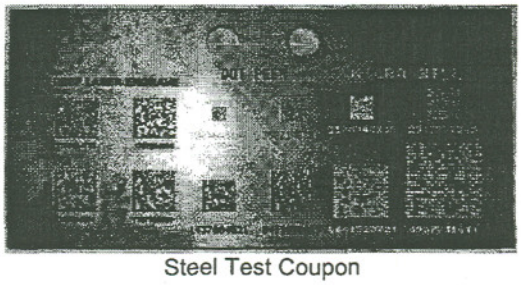
July 3, 2003

In reply refer to: SRC Letter #03-017
Job #03-029

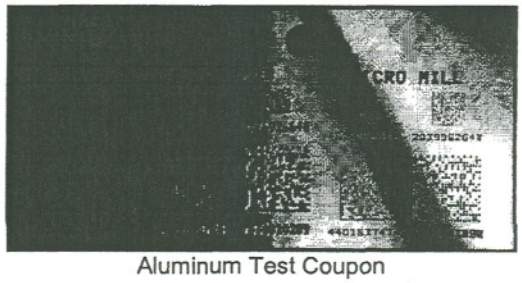
John Coates
782 East 700 South
Clearfield Utah 84015

Mr. Coates,

Enclosed are four steel and four aluminum test coupons marked with direct part marking processes for the Aging Landing Gear Life Extension Program per M-E-39035-112-10000-19. Deep laser engraved, dot peen, and machine engraved marks were applied to the coupons in accordance with drawings S1A REV D and A1A REV D. All the marks were applied to the specified depths, including the dot peen marks on steel (with specified depths of 0.002, 0.004, 0.006, and 0.008 inches). Pictures of the coupons are shown below.



Steel Test Coupon



Aluminum Test Coupon

Also enclosed are six sets of data sheets that correspond to the three marking processes applied to the steel and aluminum test coupons. These data sheets include the process controls for each marking process as well as the verification data for each mark.

Please call me should you have any questions or need additional clarification.

Sincerely,

Matthew J. Chatham
Associate Project Engineer
256.830.8123 ext 19
mchatham@rvsi.net

cc:

Agapakis, John—RVSI
England, Ray—RVSI
Howes, Curtis—RVSI
O'Brien, John—RVSI
Roxby, Don—RVSI
Hale, Steve—NCMS

RVSI
Symbology
Research Center

Why use RVSI verification?

- ONLY RVSI provides true "diagnostic" verification that is essential to diagnosis and correction of marking problems!
- ONLY RVSI provides a verification program that is IAQG (International Aerospace Quality Group) compliant:
  - Specifically addresses marking methods like dot peening
  - Requires new criteria to ensure:
    - Consistent readability
    - Moderate effect on marked material
    - Accuracy of cell placement
    - Mark depth consistency
- ONLY RVSI verification is specifically developed for, utilized by, and fully approved by Rolls Royce
- ONLY RVSI has proven experience integrating verification into various types of marking machines to control the quality of the mark.
- ONLY RVSI has verification that can be used to improve the mark quality in a closed loop process:
  - ONLY RVSI provides verification that measures center off-set:
    - Verification of center off-set measures the accuracy of cell placement - how much the marking machine is varying between marks as a result of marking machine wear-down
  - ONLY RVSI provides verification that measures print growth on entire Data Matrix symbol:
    - As opposed to competitive verification systems that only verify the print growth on a few cells on the border of the Data Matrix, RVSI's verification system verifies the print growth on the entire Data Matrix symbol. This provides a significantly more accurate verification as you are able to identify cell variations throughout the entire code that would be missed by all other verification systems. RVSI's verification solution measures the cells that hold the data, not just the finder pattern.
  - ONLY RVSI provides cell modulation:
    - Cell modulation is the variation in quality of the cells within the Data Matrix code. If the marking equipment is not marking consistently, (even if the quality differs between just one cell within the symbol), RVSI verification can identify it with ease. The verification of cell modulation enables you to catch problems within the symbol cells when they are diminishing in quality and provides a means of catching potential larger code problems (i.e. when the entire cell disappears) prior to the use of error correction.
    - This feature will soon be incorporated in a new ISO standard (ISO/IEC 15415). RVSI is the verification industry leader and will be compliant with this new standard.
  - ONLY RVSI provides cell size off-set:
    - Cell size off-set is the measurement of consistency in size from one cell to another. This feature ensures the marking system creates consistent symbols and enables us to identify mark quality errors before they become costly.

RVSI, Symbology Research Center, 5000 Bradford Dr. NW, Suite A, Huntsville, AL 35805 Tel: 256-830-8123 Fax: 256-895-0585

COUPON S1A

Part 1. PART DESCRIPTION

Part Type: Test Coupons	Basic Shape: Flat
Surface Coatings/Texture: Profiled	Overall Dimensions (mm): 7.75 x 3.75 x 0.375

Part 2. MATERIAL DESCRIPTION

Material Family: Steel	Material Type: 4340 per AMS 6415

Part 3. EQUIPMENT DESCRIPTION

Manufacturer:	Sic Marking	Equipment Type:	Dot Peen Marker
Model Number:	C-151ZA	Serial Number:	23566
Software Revision:	e6-4a04		

Part 4. MARKING PARAMETERS

Stylus Dia (mm):	4	Marking Speed:	0	
Tip Angle:	120°			
Depth of Mark (in):	0.002	0.004	0.006	0.008
Force Level:	4	6	9	7 (2 passes)
Stylus to Part Gap:	1	3	6	8 (2 passes)
Marking Time (seconds):	18	27	34	88

Part 5. SYMBOL PARAMETERS

Symbol Type:	Data Matrix	Number of Characters:	10	
Rows x Columns:	22 x 22	ECC Level:	200	
Type:	Square	Style:	Normal	
Depth of Mark (in):	0.002	0.004	0.006	0.008
Symbol Size (in):	0.20	0.33	0.47	0.60
Cell Size (in):	0.009	0.015	0.021	0.027

Part 6. READER PARAMETERS

Processor:	DMx Auto ID	Camera:	RVSI CM4000	
Camera Gain:	½ turn CW	Gamma:	1.0, MGC, FRM	
Lens Type:	Tamron 701178	Lens Size:	1:2.8, 50mm, Ø25.5	
Software Version no.:	1.5.0.20	Trigger Method:	Manual	
Field Mode (Low Density): No		Frame Mode (High Density): Yes		
Depth (in):	0.002	0.004	0.006	0.008
Aperture Setting:	12	16	22	22
Extension Tube (mm):	30	20	10	10
Focus Setting:	1.0	1.5	0.7	1.0

Camera to Target Distance (mm):	126	160	225	253
Symbol Size (Pixels):	353 x 357	388 x 385	369 x 366	401 x 400

Part 7. LIGHTING PARAMETERS

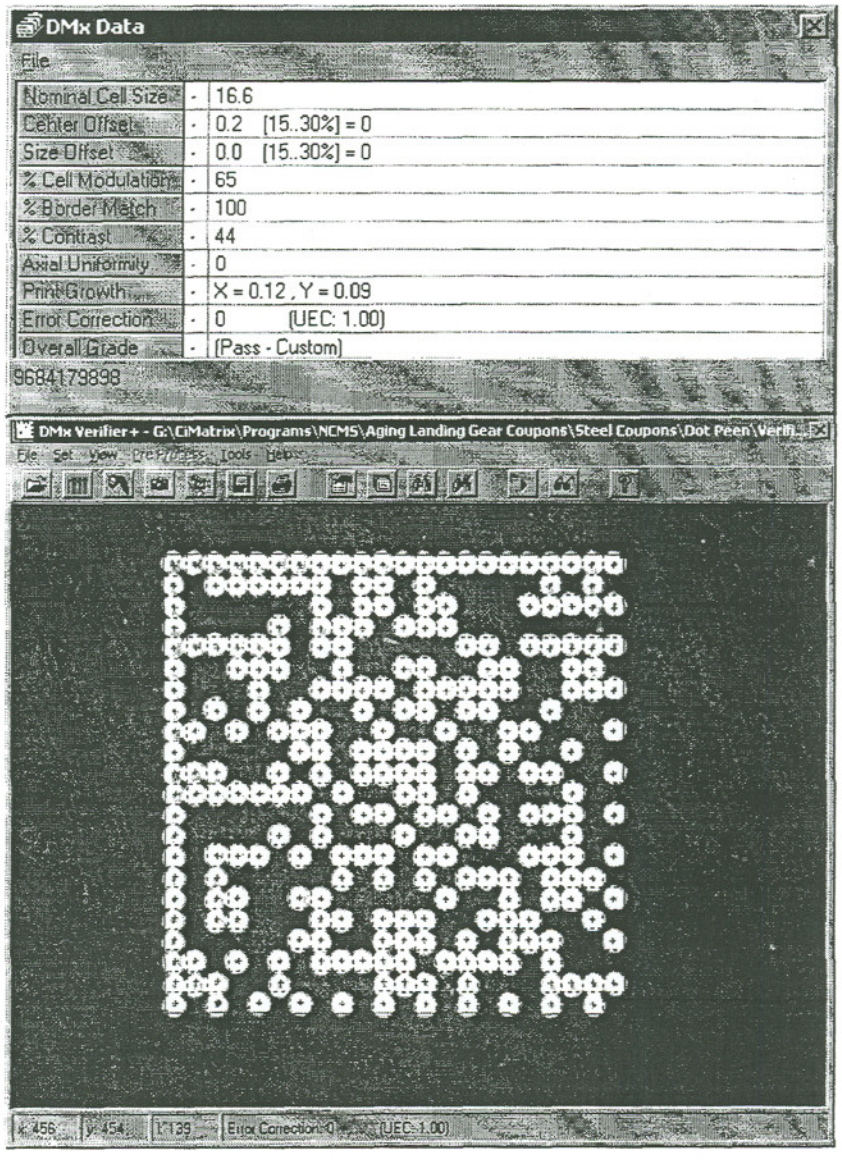
Light manufacturer: NER		Light type: DF-150-3 (Ring Illuminator)	
Light P/N: 010-602302		Light Color: Red	
Lighting Angle: Parallel to part surface		Filter Type: None	
Depth of Mark (in):	0.002	0.004	0.006	0.008
Lighting Distance (mm):	49	36	23	30

Part 8. DECODING RESULTS

		Nominal Cell Size	Center Offset	Size Offset	Cell Modulation	Border Match	Contrast	Axial Uniformity	Print Growth (X)	Print Growth (Y)	Error Correction
S1A-17											
3284645196	0.002	16.3	1.6	1.6	40	100	54	0	0	-0.03	0
3577148088	0.004	17.5	0.2	0.0	53	100	50	0	0.11	0.12	0
1437884521	0.006	**Dot Peen equipment malfunction: Not a valid mark**									
0412058609	0.008	18.1	0.2	0.3	71	100	45	0	0.11	0.09	0
S1A-18											
3121360435	0.002	16.3	4.0	7.3	55	100	45	0	-0.11	-0.15	0
1385908572	0.004	17.7	11.8	10.7	55	99	52	0	0	-0.08	0
4346733799	0.006	16.6	0.0	0.8	60	100	45	0	0.12	0.10	0
2734164898	0.008	18.2	4.0	3.4	67	100	52	0	0.06	0.08	0
S1A-19											
2344801832	0.002	16.2	7.8	9.5	43	90	46	0	-0.10	-0.27	1
3803098618	0.004	17.6	8.5	9.9	60	100	49	0	0.02	-0.09	0
1171132250	0.006	16.7	3.0	3.3	48	100	46	0	0.09	0.05	0
6994100179	0.008	18.2	0.3	1.7	77	100	51	0	0.11	0.03	0
S1A-20											
3109726188	0.002	16.2	1.2	0.8	54	100	54	0	-0.04	-0.10	0
0444048107	0.004	17.6	2.8	4.6	44	100	54	0	0.08	0.04	0
9684179898	0.006	16.6	0.2	0.0	65	100	44	0	0.12	0.09	0
0613743092	0.008	18.2	0.2	0.2	72	100	50	0	0.13	0.08	0

Part 9. Symbol Quality Verification

The following image is a screen shot of the RVSI Data Matrix Verifier. This software tool is used to 'grade' the quality of a mark and unlike the standard "AIM Verification" available from other reader companies (which is designed to read paper labels), it provides feedback related to the direct marking of parts on any material. Please see the attached document that explains RVSI Verification more thoroughly.



Appendix A

Direct Part Mark Verification for Data Matrix Codes

The AIM symbology specification calls out the Data Matrix verification methodology as the measure of: Symbol Contrast; Print Growth; Axial Non-uniformity; and, Unused Error Correction. A final grade of the mark quality will be the lowest grade given in the previously cited categories. The AIM method follows what was done for Bar Code Verification many years ago and has validity where Matrix Codes are applied to labels (essentially we are measuring the label printer quality).

With directly marked parts, this AIM method misses several key measures and will almost always report a final score based on the Symbol Contrast score, which with most direct marks will be very low and meaningless as it is not something we can control (peening a metallic surface seldom adds any contrast). If a company relies exclusively on AIM parameters they will likely fail completely readable marks and accept some marks that will later prove to be unreadable.

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We refer to this system approach as the MVRC^{sm} Methodology (Mark, Verify, Read, and Communicate). It is only available from RVSI.

DATA SHEET
Job No.: 03-029
Engineer: M. Chatham

Report No.: SRC-L-310
Date: June 30, 2003

Part 1. PART DESCRIPTION

Part Type: Test Coupons	Basic Shape: Flat
Surface Coatings/Texture: Profiled	Overall Dimensions (mm): 7.75 x 3.75 x 0.375

Part 2. MATERIAL DESCRIPTION

Material Family: Steel	Material Type: 4340 per AMS 6415

Part 3. EQUIPMENT DESCRIPTION

Marking Company:	Virtek Laser Systems, Inc.
Marking Engineer:	Andrew Money

Part 4. MARKING PARAMETERS

Marking Speed: 150 mm/sec		Frequency: 8000 Hz		
Laser Power: 28 amps				
Depth of Mark (in):	0.002	0.004	0.008	0.012
Marking Time (seconds):	84	150	366	582

Part 5. SYMBOL PARAMETERS

Symbol Type:	Data Matrix	Number of Characters:	10
Rows x Columns:	22 x 22	ECC Level:	200
Type:	Square	Style:	Normal
Symbol Size (in):	0.65	Cell Size (in):	0.030

Part 6. READER PARAMETERS

Processor:	DMx Auto ID	Camera:	RVSI CM4000
Camera Gain:	½ turn CW	Gamma:	1.0, MGC, FRM
Lens Type:	Tamron 701178	Lens Size:	1:2.8, 50mm, ∅25.5
Software Version no.:	1.5.0.20	Trigger Method:	Manual
Field Mode (Low Density): No		Frame Mode (High Density): Yes	
Aperture Setting:	8	Extension Tube (mm):	10
Focus Setting:	3.0	Camera to Target Distance (mm):	279
Symbol Size (Pixels):	358 x 358		

Part 7. LIGHTING PARAMETERS

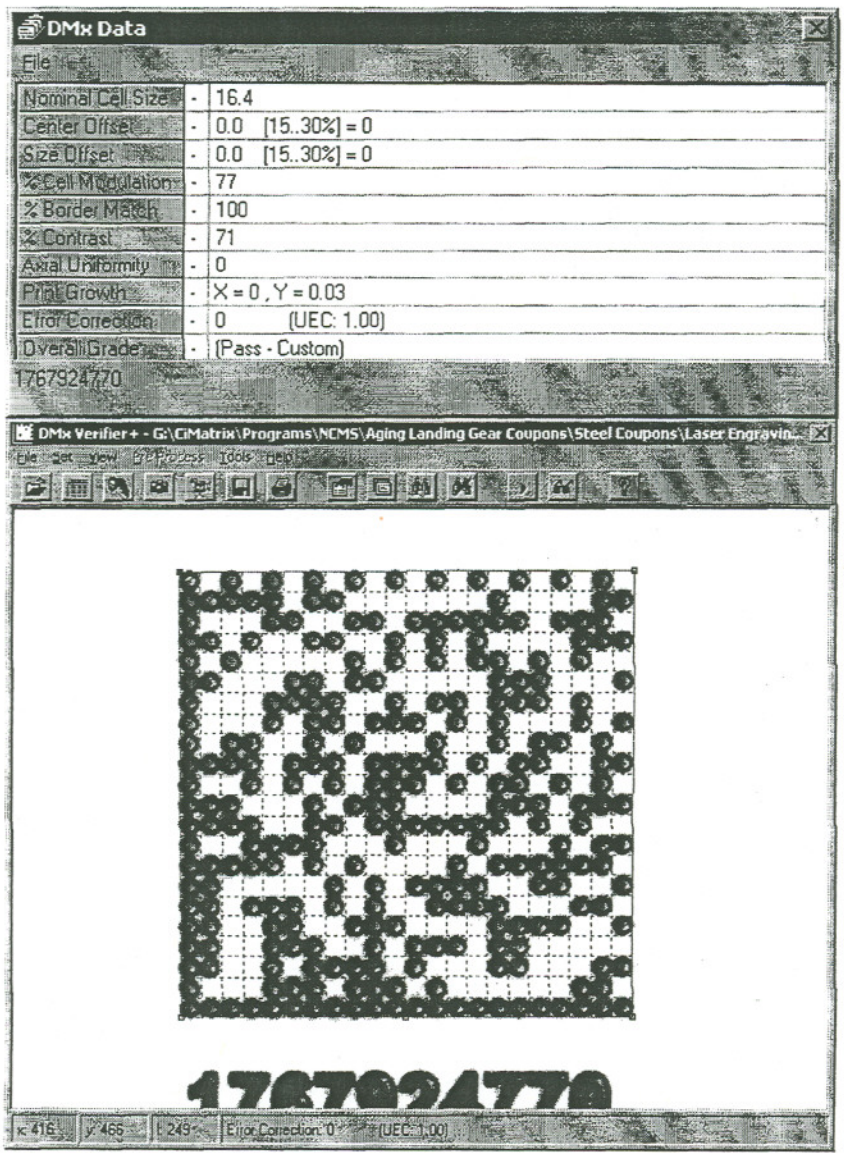
Light manufacturer:	NER	Light type:	DOAL-75-LED
Light P/N:	010-200500	Light Color:	Red
Lighting Angle:	Parallel to part surface	Filter Type:	None
Lighting Distance (mm):	42		

Part 8. DECODING RESULTS

		Nominal Cell Size	Center Offset	Size Offset	Cell Modulation	Border Match	Contrast	Axial Uniformity	Print Growth (X)	Print Growth (Y)	Error Correction
S1A-17											
1767924793	0.002	16.3	1.5	0.0	76	100	67	0	0.05	0	5
1767924805	0.004	16.3	0.0	0.0	74	100	76	0	0.03	0.02	0
1767924834	0.008	16.3	0.0	0.0	79	100	77	0	0.03	0.02	0
1767924851	0.012	16.3	0.0	0.0	72	100	79	0	0.05	0.06	0
S1A-18											
1112312379	0.002	16.3	2.3	3.4	84	100	65	0	0.02	-0.03	0
1112312382	0.004	16.3	2.4	1.6	77	100	66	0	0.03	-0.02	0
1112312411	0.008	16.3	0.0	0.0	73	100	69	0	0.04	0.03	0
1112312428	0.012	16.3	0.0	0.0	75	100	70	0	0.04	0.05	0
S1A-19											
1767924712	0.002	16.3	1.2	3.3	83	100	65	0	-0.08	-0.02	0
1767924724	0.004	16.4	2.3	2.6	79	99	68	0.02	0.05	-0.02	0
1767924753	0.008	16.4	0.0	0.0	77	100	70	0	0.05	0.02	3
1767924770	0.012	16.4	0.0	0.0	77	100	71	0	0	0.03	0
S1A-20											
1298412311	0.002	16.3	1.5	4.2	80	100	62	0	-0.03	-0.05	0
1298412314	0.004	16.2	1.0	2.6	75	99	67	0	0.03	-0.04	0
1298412343	0.008	16.3	0.0	0.0	75	100	71	0	0.02	0	0
1298412343	0.012	16.3	0.0	0.0	79	100	74	0	0.05	0.05	0

Part 9. Symbol Quality Verification

The following image is a screen shot of the RVSI Data Matrix Verifier. This software tool is used to 'grade' the quality of a mark and unlike the standard "AIM Verification" available from other reader companies (which is designed to read paper labels), it provides feedback related to the direct marking of parts on any material. Please see the attached document that explains RVSI Verification more thoroughly.



Appendix A

Direct Part Mark Verification for Data Matrix Codes

The AIM symbology specification calls out the Data Matrix verification methodology as the measure of: Symbol Contrast; Print Growth; Axial Non-uniformity; and, Unused Error Correction. A final grade of the mark quality will be the lowest grade given in the previously cited categories. The AIM method follows what was done for Bar Code Verification many years ago and has validity where Matrix Codes are applied to labels (essentially we are measuring the label printer quality).

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RVSI has attacked the identification of parts for traceability and process control as a system problem that requires a system solution. The right marking methods must first be chosen (the SRC has validated over 50 methods of marking parts); the use of Verification after marking to confirm the mark quality is a must (provided the proper measurements are made); application engineering to accommodate the environmental conditions encountered at the read stations, both fixed and hand held, must be taken into consideration (and they should both use the same algorithmic approach to minimize integration); and finally the communication of the data must support the factory environment and traceability needs of the user.

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DATA SHEET
Job No.: 03-029
Engineer: M. Chatham

Report No.: SRC-CNC-002
Date: June 30, 2003

Part 1. PART DESCRIPTION

Part Type: Test Coupons	Basic Shape: Flat
Surface Coatings/Texture: Profiled	Overall Dimensions (mm): 7.75 x 3.75 x 0.375

Part 2. MATERIAL DESCRIPTION

Material Family: Steel	Material Type: 4340 per AMS 6415

Part 3. EQUIPMENT DESCRIPTION

Manufacturer: Servo Products Co.	Equipment Type: CNC Milling Machine
Model Number: Impact 2	Serial Number: I-01430CBS
Software Revision: 5.02(94)	

Part 4. MARKING PARAMETERS

Drill Bit Material: Cobalt	Marking Time (Seconds): 30 minutes
Drill Bit Dia (in): 1/16	Tip Angle: 135°
Feed Rate (ipm): 0.60	Speed (RPM): 1500

Part 5. SYMBOL PARAMETERS

Symbol Type: Data Matrix	Number of Characters: 10
Rows x Columns: 22 x 22	ECC Level: 200
Type: Square	Style: Normal

Depth of Mark (in):	0.002	0.004	0.008	0.012
Symbol Size (in):	0.3432	0.4884	0.8316	1.1770
Cell Size (in):	0.0156	0.0222	0.0378	0.0535

Part 6. READER PARAMETERS

Processor: DMx Auto ID	Camera: RVSI CM4000
Camera Gain: ½ turn CW	Gamma: 1.0, MGC, FRM
Lens Type: Tamron 701178	Lens Size: 1:2.8, 50mm, Ø25.5
Software Version no.: 1.5.0.20	Trigger Method: Manual
Field Mode (Low Density): No	Frame Mode (High Density): Yes

Depth (in):	0.002	0.004	0.008	0.012
Aperture Setting:	6	8	16	16
Extension Tube (mm):	20	15	5	5
Focus Setting:	1.0	∞	0.7	2.2
Camera to Target Distance (mm):	160	205	330	450
Symbol Size (Pixels):	407 x 402	388 x 387	392 x 386	379 x 379

Part 7. LIGHTING PARAMETERS

Light manufacturer:	NER				Light type:	DF-150-3 (Ring Illuminator)					
Light P/N:	010-602302				Light Color:	Red					
Lighting Angle:	Parallel to part surface				Filter Type:	None					
Depth of Mark (in):		0.002			0.004			0.008			0.012
Lighting Distance (mm):		94			76			57			62

Part 8. DECODING RESULTS

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S1A-17											
3178940236	0.002	18.4	0.4	1.5	12	99	32	0	0.22	0.22	3
2937231265	0.004	17.8	0.9	2.9	63	100	33	0	0.04	0.11	0
8661523721	0.008	17.8	6.2	9.3	46	100	58	0	-0.11	-0.06	1
6937731644	0.012	17.4	1.7	1.6	70	100	60	0	-0.05	0	0
S1A-18											
0321447293	0.002	16.4	2.0	4.6	38	89	74	0	0.12	0.12	2
7472580000	0.004	18.6	2.5	6.6	58	100	40	0	0.11	0.18	4
4238403351	0.008	17.9	3.2	3.5	66	100	56	0	-0.15	-0.11	0
7320244897	0.012	17.3	6.6	7.6	51	99	60	0	-0.16	0	0
S1A-19											
3604629434	0.002	17.9	1.7	6.9	43	100	68	0	-0.35	-0.36	1
7083951874	0.004	17.6	0.2	0.0	48	100	41	0	0	0.04	0
4056101281	0.008	17.9	1.2	2.2	82	100	62	0	-0.17	-0.11	0
9047138054	0.012	17.5	1.6	2.6	75	100	62	0	-0.16	-0.12	0
S1A-20											
0449567964	0.002	17.9	4.3	6.6	35	87	66	0	0.11	0.19	2
4665343274	0.004	17.7	4.4	6.4	50	100	42	0	0	0	0
3518231552	0.008	18.0	2.2	4.8	67	100	58	0	-0.11	-0.11	0
7575746356	0.012	17.5	2.8	5.2	65	100	59	0	-0.19	-0.12	0

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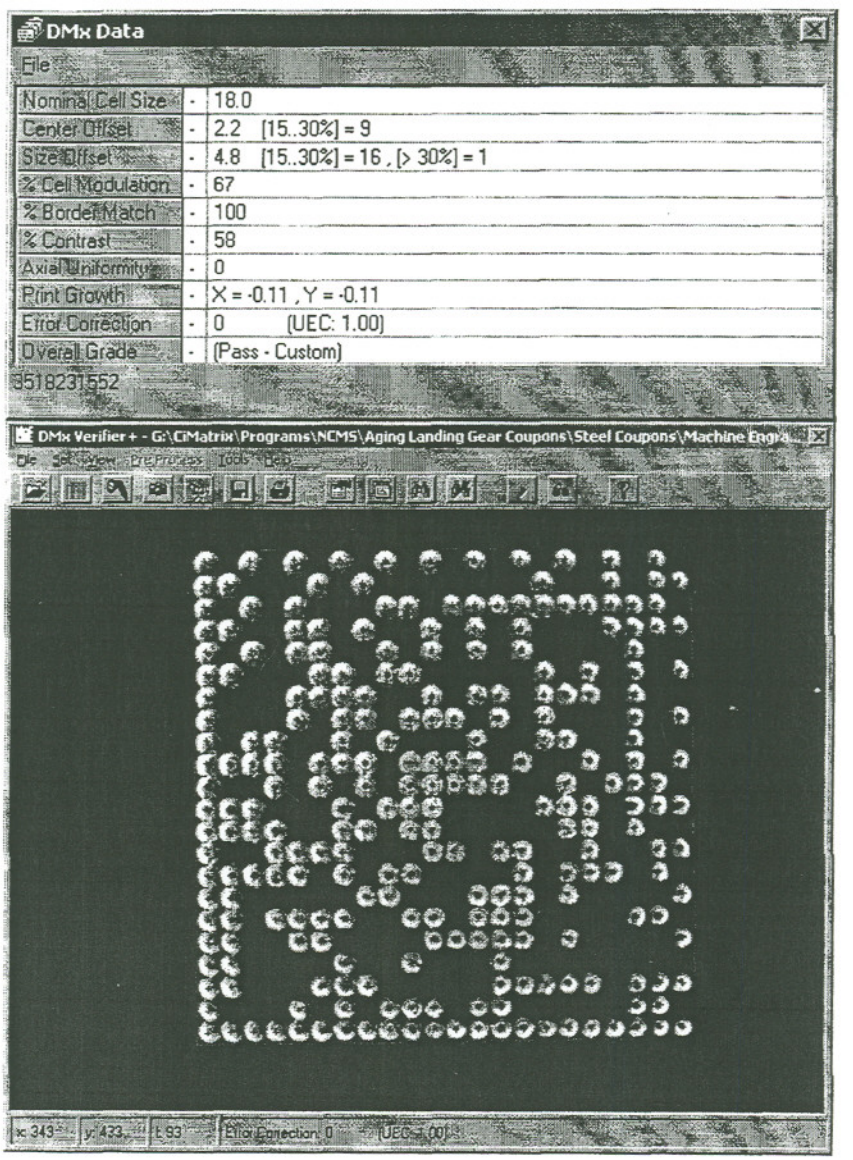

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